Amendments to the Specification:

On page 1, please amend ¶ [0001] as follows:

This application is a division of U.S. Patent Application Serial No. 09/976,946, filed October 12, 2001, now U.S. Patent No. 6,724,281, which is a division of U.S. Patent Application Serial No. 09/429,812, filed October 29, 1999, now U.S. Patent No. 6,590,477, the contents of all of which are hereby incorporated herein by reference.

On page 4, please amend ¶ [0017] as follows:

Figure 3 shows a plot of bandwidth vs. bandwidth density/layer for a 0.5 m FR-4 backplane, and 1 m and 0.75m prepreg backplanes respectively.

On page 5, please amend ¶ [0033] as follows:

Figure 16 shows a plot of inter-waveguide crosstalk vs. frequency for the prior art waveguide system of Figure 13A.

On page 5, please amend ¶ [0034] as follows:

The attenuation (A) of a broadside coupled PCB conductor pair data channel has two components: a square root of frequency (f) term due to conductor losses, and a linear term in frequency arising from dielectric losses. Thus,

$$A = (A_1 * SQRT(f) + A_2 * f) * L * (8.686 \text{ db/neper}) \qquad (1)$$

where

$$Al = (\pi * \mu_0 * \rho)^{0.5} / (w/p) * p * Z_0 \qquad (2)$$

and

$$A_2 = \pi * DF * (\mu_0 * \varepsilon_0)^{0.5}. \text{ [[(3)]]} \qquad \underline{(3)}$$

The data channel pitch is p, w is the trace width, ρ is the resistivity of the PCB traces, and ε and DF are the permittivity and dissipation factor of the PCB dielectric, respectively. Note that $Z_0 = (\mu_0 / \varepsilon_0)^{0.5}$. For scaling, w/p is held constant at -0.5 or less and Z_0 is held constant by making the layer spacing between traces, h, proportional to p where h/p = 0.2. The solution

of Equation (1) for A = 3dB yields the 3dB bandwidth of the data channel for a specific backplane length, L.

On page 7, please amend ¶ [0040] as follows:

Figure 5 depicts a closed, extruded, conducting pipe, rectangular waveguide 10. Waveguide 10 is generally rectangular in cross-section and is disposed along a waveguide axis 12 (shown as the z-axis in Figure 5). Waveguide 10 has an upper broadwall 14 disposed along waveguide axis 12, and a lower broadwall 16 opposite and generally parallel to upper broadwall 14. Waveguide 10 has a pair of sidewalls 18A, 18B, each of which is generally perpendicular to and connected to broadwalls 12 and 14. Waveguide 10 has a width a <u>along the x-axis,</u> and a height b <u>along the 7-axis</u>. Height b is typically less than width a. The fabrication of such a waveguide for backplane applications can be both difficult and expensive.

On page 7, please amend ¶ [0042] as follows:

According to the present invention, a longitudinal gap is introduced in the broadwalls so that the current and field patterns for the TE 1,0 mode are unaffected thereby. As shown in Figure 7A, a waveguide 100 of the present invention includes a pair of conductive channel[[s]] 102A[[,]] <u>and channel</u> 102B. First channel 102A is disposed along a waveguide axis 110. Second channel102B is disposed generally parallel to first channel 102A to define a gap 112 between first channel 102A and second channel 102B.

On page 7, please amend ¶ [0044] as follows:

Waveguide 100 has a width a and <u>a</u> height b. To ensure suppression of the TE n,0 modes for even values of n, the height b of waveguide 100 is defined to be about 0.5a or less. The data channel pitch p is approximately equal to a. The dimensions of waveguide 100 can be set for individual applications based on the frequency or frequencies of interest. Gap 112 can have any width, as long as an interruption of current occurs. Preferably, gap 112 extends along the entire length of waveguide 100.

On page 8, please amend ¶ [0045] as follows:

As shown in Figure 7A, each channel 102A[[,]] and channel 102B has an upper broadwall 104A, 104B, a lower broadwall 106A, 106B opposite and generally parallel to its upper broadwall 104A, 104B, and a sidewall 108A, 108B generally perpendicular to and connected to broadwalls 104, 106. Upper broadwall 104A of first channel102A and upper broadwall 104B of second channel 102B are generally coplanar. Gap 112 is defined between upper broadwall 104A of first channel 102A and upper broadwall 104B of the second channel 102B.

On page 8, please amend ¶ [0048] as follows:

Unlike the conventional systems described above, the attenuation in a waveguide [[110]] 100 of present invention is less than 0.2 dB/meter and is not the limiting factor on bandwidth for backplane systems on the order of one meter long. Instead, the bandwidth limiting factor is mode conversion from a low order mode to the next higher mode caused by discontinuities or irregularities along the waveguide. (Implicit in the following analysis of waveguide systems is the assumption of single, upper-sideband modulation with or without carrier suppression.)

On page 10, please amend ¶ [0055] as follows:

Waveguide 20 can support both an even and an odd longitudinal magnetic mode (relative to the symmetry of the magnetic field in the direction of propagation). The even mode has a cutoff frequency, while the odd mode does not. The field patterns in waveguide 20 for the desired odd mode are shown in Figure 13B (where the x-axis is frequency and the y-axis is amplitude). The fields in dielectric channel 22 (i.e., the region between -a/2 and a/2 as shown in Figure 13B and designated "dielectric") are similar to those of the TE 1,0 mode in rectangular waveguide 10 described above, and vary as Ey ~ cos(kx) and Hz ~ sin(kx). Outside of dielectric channel 22, however, in the regions designated "air," the fields decay exponentially with x, i.e., exp(-τx), because of the reactive loading of the air spaces on the left and right faces 22L, 22R (see Figure 13A) of dielectric channel 22.

On page 11, please amend ¶ [0057] as follows:

Since the fields outside the dielectric 22 decay exponentially, two or more NRD waveguides 30 can be laminated between substrates ~~24U, 24L~~ 28U, 28L, such as ground plane PCBs, to form a periodic multiple bus structure as illustrated in Figure 15A. As shown, the bus structure can include a plurality of dielectric channels 22, each having a width, a, alternating with a plurality of air filled channels 26. The dielectric channel 22 and adjacent air filled channel 26 have a combined width p. The first order consequence of the coupling of the fields external to dielectric 22 is some level of crosstalk between the dielectric waveguides 30. This coupling decreases with increasing pitch, p, and frequency, F, as illustrated in Figure 16, wherein p=3a with p = to the waveguide pitch and a = width of the dielectric channel. Therefore, the acceptable crosstalk levels determine the minimum waveguide pitch p_{min}.

On page 11, please amend ¶ [0058] as follows:

According to the present invention, and as shown in Figure 15B, a longitudinal gap can be used to prevent the excitation and subsequent propagation of the higher order even mode~~, which has a transverse current maximum in the top and bottom ground plane structures at x = 0~~. Figure 15B depicts an NRD waveguide backplane system 120 of the present invention. Waveguide backplane system 120 includes an upper conductive plate 124U, and a lower conductive plate 124L disposed opposite and generally parallel to upper plate 124U. Preferably, plates 124U and 124L are made from a suitable conducting material, such as a copper alloy, and are grounded.

On page 12, please amend ¶ [0060] as follows:

The bandwidth of the TE 1,0 mode NRD waveguide is dependent on the losses in dielectric and the conducting ground planes. For the case where b ~ a/2, and the approximation to the eigenvalue

$$k \sim (\omega/c)(Dr\underline{-}\ 1)^{0.5} \sim 2/a, \qquad (11)$$

holds. The attenuation has two components: a linear term in frequency proportional to the dielectric loss tangent, and a 3/2 power term in frequency due to losses in the conducting

ground planes. For an attenuation of this form

$$a = (a_1)(f)^{1.5} + (a_2)f \qquad (12)$$

where a1 and a2 are constants. The bandwidth length product, BW*L, based on the upper side band 3 dB point is

$$BW*L \sim (0.345/a_2) / (1/2)(a_1/a_2)(f_0)^{0.5} + 1 \qquad (13)$$

where BW/f0 < 1, and f0 is the nominal carrier frequency. Preferably, pitch p is a multiple of width a. Then, from (3), f0 is proportional to 1/p. Also, bandwidth density BWD = BW/p. Plots of the bandwidth and bandwidth density characteristics for a "TEFLON" NRD waveguide, and for a Quartz NRD guide having Dr = 4 and a loss tangent of 0.0001 are shown in Figure 9. For these plots p = 3a. Thus, like the characteristics of rectangular waveguide 100, NRD waveguide 120 offers increased bandwidth and, more importantly, an open ended bandwidth density characteristic relative to the parabolically closed bandwidth performance of conventional PCB backplanes.